REMARKS/ARGUMENTS

Reexamination of the captioned application is respectfully requested.

A. SUMMARY OF THIS AMENDMENT

By the current amendment, Applicants basically:

1. Editorially amend the specification to correct an error in paragraph [0004], the error being readily apparent from its context and other references to silicon surface 1.
2. Respectfully traverse all prior art rejections.

B. PREVIOUS PROSECUTION

In the amendment filed on December 3, 2008, Applicants amended independent claim 13 to specify that the surface of the substrate having the off-angle within a range of 2 to 10 degrees from the (000-1) carbon surface is taken as the crystal growth surface of the substrate. Applicants argued that although Shiomi's {03-38} crystal growth surface has also a specified off-angle relative to the (000-1) C surface, Shiomi's off-angle is 54.74^0, which is considerably outside Applicants' claimed range of $2 – 10^0$.

Thereafter, in the March 13, 2009 non-final office action the Examiner admitted that EP 1,215,730 to Shiomi does not specifically disclose an off angle in the claimed range of 2 to 10 degrees, but alleged that U.S. Patent Publication US 2003/0080384 to Takahashi discloses an off-angle within a range of 0 to 10 degrees from the (000-1) carbon surface. As a result of the Request For Reconsideration filed on June 15, 2009 the Examiner withdrew Takahashi as the secondary reference of the previously-applied prior art combination. The non-final October 23, 2009 office action attempts to combine newly applied U.S. Patent Publication US 2005/0145971 to Okamura et al with EP 1,215,730 to Shiomi.

C. THE PRIOR ART REJECTIONS

Claims 13-15, 19 and 20 stand rejected under 35 USC 103(a) as being unpatentable over previously-applied EP 1,215,730 to Shiomi et al in view of newly applied U.S. Patent Publication US 2005/0145971 to Okamura et al. All prior art rejections are respectfully traversed for at least the following reasons.

D. PATENTABILITY OF THE CLAIMS

The office action itself senses trouble with the new prior art rejection as evidenced by the office action's own recognition that U.S. Patent Publication US 2005/0145971 to Okamura refers to a {0001} surface rather than to Applicants' claims (000-1) carbon surface. The office action seeks to diminish the {0001} vs. (000-1) distinction by reference to Applicants' own specification. But, as explained below, Applicants' Applicants' specification paragraph [0004] provides no basis for supporting the contentions of the office action or for rejecting Applicants' independent claims.

The last full paragraph of page 4 of the office action as well as the paragraph bridging pages 4 and 5 include several mischaracterizations or misunderstandings which apparently prompt the faulty conclusions of the office action. Several of these mischaracterizations/misunderstandings are discussed below.

In the first sentence of the last full paragraph of page 4 the office action alleges that "Okamura (paragraph 57) discloses a [0001] surface orientation wherein the off-angle is 8 degrees (1 to 10 degrees) from the (000-1) carbon surface." This sentence incorrectly characterizes Okamura paragraph [0057], which instead reads "substrate… having a surface orientation of {0001} and having an off angle of 8^0." The office action thus mistakenly substitutes the claim nomenclature "**[**0001**]** " for the actual Okamura nomenclature "**{**0001**}**". But such substitution is improper since the nomenclature difference is significant. The following nomenclature is common knowledge in the art:

an individual surface is expressed by the nomenclature “( )”; a set surface is by is expressed by the nomenclature “{ }”; an individual direction is expressed by the nomenclature “[ ]”; and a set direction is expressed by the nomenclature “< >”. See, for example, paragraph [0033] of Applicants’ application.

The first sentence of the last full paragraph of page 4 the office action also erroneous alleges that “Okamura (paragraph 57) discloses a [0001] surface orientation wherein the off-angle is 8 degrees (1 to 10 degrees) from the *(000-1) carbon surface”* (emphasis added). Nowhere does Okamura (paragraph 57) refer to a “(000-1) carbon surface” as alleged by the office action. Rather, Okamura (paragraph 57) instead mentions a “surface orientation of {0001}”.

The office action also mischaracterizes Applicants’ specification paragraph 0004. In particular, the third sentence of the last full paragraph of page 4 the office action alleges that paragraph 0004 of the specification states that “A [0001] surface is represented by a plane of SiC crystal, includes a (0001) silicon surface 1 and a (000-1) carbon surface 2…”. Again the office action confuses nomenclature, since paragraph 0004 of the specification actually reads as follows: “A **{**0001**}** surface, which represents a set plane of SiC crystal, includes a (0001) silicon surface 1 and a (000-1) carbon surface 2, …” (boldface emphasis added). Note the nomenclature difference between the office action’s incorrect characterization of Applicants’ {0001} surface as being a “[0001] surface”.

As stated in the last sentence of the last full paragraph of page 4 the office action, “the Examiner takes the position that the Okamura’s teachings of an off-angle of 8 degrees represents an off-angle of 8 degrees of/from all the parallel surfaces.” It is hoped that the Examiner will correct such position in view, e.g., of the foregoing

corrections and ensuing discussion of U.S. Patent Publication US 2005/0145971 to Okamura.

Okamura describes in paragraph [0058] (referring to Fig. 1) that "one surface is a silicon surface 11, and the other surface thereof is a carbon surface 12". As shown in Okamura Fig. 1, the upper surface 11 of the Okamura N-SiC substrate 1 is the silicon surface and the lower surface 12 thereof is the carbon surface. If anything in Okamura were alleged to correspond to Applicants' drift layer 23, it would have to be N-type SiC epitaxial layer 10. And yet Okamura's N-type SiC epitaxial layer 10 is formed on the side of the upper silicon surface 11 of the substrate 1, rather than on the lower carbon surface 12 of the substrate 1.

The independent claims require that the drift layer be formed on a crystal growth surface which has an off-angle from a (000-1) carbon surface. The fact that Okamura's epitaxial layer 10 is formed on the side of upper silicon surface 11 rather than the lower carbon surface 12 renders Okamura irrelevant to the independent claims. One would not take from Okamura a suggestion that the off angle of Shiomi be modified according to the range of Okamura since Okamura's off angle pertains to an entirely different structure (e.g., Okamura's off angle does not pertain to a surface upon which a drift layer is formed, especially since in Okamura any structure which might be alleged analogous to a drift layer is formed elsewhere).

Nor would the person skilled in the art be motivated by Fig. 1 of Okamura to form Okamura's epitaxial layer 10 as well as metal layers 3 and 5 (borne on Okamura's upper silicon surface 11) instead on Okamura's lower carbon surface 12 of the substrate 1 where the metal layer 2 is already formed.

The office action allegation that Applicants' (0001) silicon surface 1 and (000-1) carbon surface 2 are parallel does not support the rejection. The Office should realize

that these two surfaces are not equivalent. Rather, these two surfaces are quite different in physical property as described at paragraphs [0041]-[0043] of applicants' present specification due, e.g., to the fact that the (0001) silicon surface is terminated by silicon while the (0001) carbon surface is terminated by carbon (See paragraph [0004] in the present specification).

Moreover, the Office should also appreciate that the structure and operation of the Okamura device is different than a bipolar semiconductor device. The Schottky barrier diode of Okamura is not a bipolar semiconductor device but is instead a unipolar semiconductor device. Okamura's Schottky barrier diode is made of SiC in conventional practice and grown on the (0001) silicon surface of SiC substrate (the type of prior art described at paragraphs [0003] and [0004] in Applicants' specification). It would not be reasonable to look to a unipolar semiconductor device for an alleged teaching of off-angle, and particularly not when the surfaces have differing functions.

With further reference to lack of motivation to modify, Applicants traverse the allegations of the paragraph bridging pages 4 and 5 of the office action. For example, applicants do not understand that is meant by "the purpose of suppressing macro steps applicable to growth of a material other than SiC and improving fabrication efficiency". In any event, such alleged motivation is entirely irrelevant to the problem addressed by either Shiomi or applicants. Moreover, neither reference Shiomi or Okamura realize Applicants' advantage of providing a semiconductor device having high reliability by suppressing forward voltage deterioration as described at paragraph [0010].

Applicants believe that the foregoing amply demonstrates patentability of the independent claims. Various dependent claims have separate patentable merit. While not attempting to extol all such dependent claims at this point in time, applicants nevertheless correct and respond to certain allegations in the office action.

Regarding dependent claim 15, the office action alleges that Shiomi discloses "a semiconductor layer (items 16, 12) which is formed on the drift layer and which is of a second-conductive-type silicon carbide to serve as an anode". However, item 16 in Fig. 6 of Shiomi (paragraph [0086]) denotes a high-resistance p-type region (guard ring) and does not serve as an anode as claimed. Moreover, item 12 in Fig. 6 of Shiomi (paragraph [0085]) denotes a Schottky electrode made of Ti and is not made of silicon carbide as claimed.

Regarding dependent claim 19, the office action alleges that Shiomi discloses "(Fig. 6, page 9, paragraph 82 to page 10, paragraph 92) wherein the film that is to serve as a drift layer (item 6) and that is formed by epitaxial growth of silicon carbide is formed at a film growth rate having a film-thickness increasing rate per hour of 10 pm/h or more". But in fact Shiomi discloses in Example 3 (portions pointed out by the Examiner) especially paragraphs [0083] and [0084] that "the active layer 6, which corresponds to the claimed drift layer (23), has thickness of 16 μm and growth time of 240 minutes". Thus, the Shiomi film-thickness increasing rate per hour results in 4 μm/h which is less than the claimed 10 μm/h.

Thus, applicants' film-thickness increasing rate per hour is outside of and does not overlap with Shiomi's range. By the claimed film-thickness increasing rate, as is described paragraph [0022] - [0024] at the present specification, super-saturation on the growth surface of (000-1) carbon surface can be decreased so that propagation of the basal plane dislocation from the substrate to the epitaxial film can be suppressed. As a result, the forward voltage deterioration can be prevented and high-reliability bipolar device can be realized. With the use of such a high-reliability bipolar device, power conversion equipment, such as inverters, which are reduced in loss, capable of long-term operation and high in reliability can be implemented. Therefore, the claimed film-thickness increasing rate has definite advantages for the product.

E. **MISCELLANEOUS**

In view of the foregoing and other considerations, all claims are deemed in condition for allowance. A formal indication of allowability is earnestly requested.

The Commissioner is authorized to charge the undersigned's deposit account #14-1140 in whatever amount is necessary for entry of these papers and the continued pendency of the captioned application.

Should the Examiner feel that an interview with the undersigned would facilitate allowance of this application, the Examiner is encouraged to contact the undersigned.

Respectfully submitted,
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